REMARKS

This Amendment responds to the Office Action dated April 29, 2005 in which the Examiner rejected claims 1-3 under 35 U.S.C. §103.

As indicated above, claim 1 has been amended to make explicit what is implicit in the claim. The amendment is unrelated to a statutory requirement for patentability.

Claim 1 claims a polishing apparatus comprising an upper wheel, a lower wheel, a displacement-detection means and a reference table. The upper wheel is for pressing at least one workpiece to be polished. The lower wheel is for supporting the at least one workpiece. The displacement-detection means, joined to a center of the upper wheel to move together therewith, is for detecting relative vertical displacement between the upper wheel and the lower wheel. The reference table is arranged at a position opposing the displacement-detection means and is integrally fixed to the lower wheel. The reference table provides a vertical displacement-detection reference position. The at least one workpiece is polished by a relative difference in speeds between the at least one workpiece and at least one of the lower wheel and the upper wheel.

Through the structure of the claimed invention having a) a displacement-detection means for detecting relative vertical displacement and b) a reference table providing a vertical displacement-detection reference position, as claimed in claim 1, the claimed invention provides a polishing apparatus which can accurately detect the relative displacement between the upper and lower wheels so that the workpieces are reliably polished to a desired thickness. The prior art does not show, teach or suggest the invention as claimed in claim 1.

Claims 1-2 were rejected under 35 U.S.C. §103 as being unpatentable over Applicants' admitted prior art Figure 6 in view of *Katagiri et al.* (U.S. Patent No. 4,433,510).

Prior art Fig. 6 appears to disclose a known polishing apparatus for polishing a metal, a ceramic, and a semiconductor material has a configuration as shown in Fig. 6. The polishing apparatus is for polishing the upper and lower surfaces of workpieces W at the same time, and comprises an upper wheel 1 for pressing the workpieces W and a lower wheel 2 for supporting the workpieces W. The upper wheel 1 and the lower wheel 2 are coaxially arranged with each other. A plurality of carries 3, which performs a sun-and-planet rotation while holding the workpieces W, is arranged along the circumferential direction of the upper wheel 1 and the lower wheel 2 and between these two wheels. The upper wheel 1 is vertically moved by an air cylinder 7 attached to a stationary support member 6. The upper wheel 1 has a substantially spherical holder la, formed in the upper middle thereof, for holding a spherical pressure head S which is disposed at the bottom of the air cylinder 7. The pressure head 8 has an electrical micrometer 10 attached thereto as a displacement-detection means for detecting the relative displacement between the upper wheel 1 and the lower wheel 2. The electrical micrometer 10 has a main unit l0a which is fixed to the pressure head S and a probe l0b which serves as a displacement-detection rod and which is expandable with respect to the main unit l0a. The lower wheel 2 has a short cylindrical shape and has a substantially cylindrical wheel drive shaft 12 coaxially fixed thereto. In addition, the lower wheel 2 is rotatably supported by a bearing 13 and has gear teeth 12a which are formed around the outer periphery of the bottom portion of the lower wheel 2. The gear teeth 12a engage with a gear 14

which is directly connected to a wheel drive motor 15. The wheel drive shaft 12 has a carrier drive shaft 18, coaxially arranged therein and supported by a bearing 19, for rotating and revolving the carriers 3. The carrier drive shaft 18 has gear teeth 18a which are formed around the outer rim periphery of the bottom thereof and which engage with a gear 20 directly connected to a first carrier drive motor 21. The upper part of the carrier drive shaft 18 is enlarged in diameter to form a diameter-enlarged portion 18b. The diameter-enlarged portion 18b has a reference table 22. The reference table 22 is formed at the center of the upper surface of the diameter enlarged portion 18b in a projecting manner so as to be integral therewith, and against which the probe l0b of the electrical micrometer 10 abuts. Polishing the upper and lower surfaces of each of the workpieces W leads to displacement of the upper wheel 1, resulting in a gradual reduction in the distance between the upper wheel 1 and the lower wheel 2. Thus, when the amount of expansion and contraction of the probe l0b abutting against the reference table 22 changes, the main unit l0a of the electrical micrometer 10 outputs detection signals in accordance with the change in expansion and contraction. Then, a controller (not shown) determines whether or not the thickness of the workpieces W agrees with a predetermined target value on the basis of the detection output from the electrical micrometer 10. When the thickness of the workpieces W reaches the target value, the motors 15, 21, and 28 are stopped thus completing the polishing of the workpieces W. In the known polishing apparatus, the reference table 22 is fixed at the top of the carrier drive shaft 18, and the carrier drive shaft 18 is configured separately from the lower wheel 2 by the bearing 19. With this arrangement, a shaky motion of the bearing 19 or the carrier drive shaft 18 in the axial direction thereof prevents a change in expansion

and contraction of the probe l0b from accurately following the relative displacement between the upper wheel 1 and the lower wheel 2, thereby causing a detection error of the amount of polishing of the workpieces W. That is to say, detection of the relative displacement between the lower surface of the upper wheel 1 and the upper surface of the lower wheel 2 is required in order to measure an accurate amount of polishing of the workpieces W. Since the carrier drive shaft 18, to which the lower wheel 2 is fixed, is configured separately from the lower wheel 2, a slight shift of the carrier drive shaft 18 along the axial direction thereof caused by, e.g., a shaky motion of the bearing 19 and the like leads, to a change in expansion and contraction of the probe l0b. As a result, the change in expansion and contraction of the probe l0b does not accurately follow the relative displacement between the upper wheel 1 and the lower wheel 2, thereby giving rise to an error m detecting the relative displacement.

Thus, prior art Figure 6 merely discloses a reference table 22 fixed at a top of a carrier driveshaft 18 which is configured separately from the lower wheel 2 by a bearing 19. Nothing in Applicants' admitted prior art shows, teaches or suggests a reference table integrally fixed to a lower wheel as claimed in claim 1. Rather, prior art Figure 6 teaches away from the claimed invention and fixes the reference table 2 to a carrier driveshaft 18 which is separated from the lower wheel by a bearing 19.

Katagiri et al. appears to disclose a lapping machine provided with such an improved means for in-machine controlling of the thickness of the wafer-like work pieces under lapping therein. (col. 1, lines 9-12) The positioning means of the machine illustrated in FIG. 1 is composed of a set of a transmitter 13 fixedly mounted on the lower surface plate 2 at the periphery thereof and a receiver 14 fixedly

mounted on the upper surface plate 1 at the periphery thereof for receiving the signal emitted from the transmitter 13. Needless to say, the intensity of the signal received in the receiver 14 is the strongest at the moment when the receiver 14 is just above the transmitter 13 so that the maxima in the continuum of the signal received in the receiver 14 can be used as the positioning signal of the upper surface plate 1 relative to the lower surface plate 2. On the other hand, a sensor 15 is fixedly mounted on the upper surface plate 1 for detecting the width of the gap between the surface plates 1 and 2 and generating a signal corresponding to the thus detected width of the gap which is, in the first approximation, equal to the thickness of the work pieces 3 under lapping. The principle of the sensor 15 for the detection of the gap width is not limitative and various methods are known in the art. For example, the sensor 15 may be an eddy current detector of the electromagnetic coupling of the upper and lower surface plates, usually, made of cast-iron to generate an output signal corresponding to the gap width. Alternatively, the sensor 15 may be a combination of an ultrasonic emitter and a receiver for the echo of the ultrasonic waves reflected at the surface of the lower surface plate 2 to give the delay time of the echo corresponding to the gap width. At any rate, the sensor 15 is fixed on the upper surface plate 1 in the opening 16 provided in the upper surface plate 1 to directly face the lower surface plate 2. The principle of the positioning means is also not limitative. For example, the transmitter 13 may be a permanent magnet coupled with a Hall element 14 to detect the magnetic flux around the permanent magnet 13. Alternatively, the transmitter 13 may be an ultrasonic emitter coupled with an ultrasonic receiver 14. At any rate, the transmitter 13 and receiver 14 are mounted on the respective surface plates 2 or 1 in such a manner that the latter passes just

above the former as the surface plates are rotated relative to each other. (col. 4, line 31 through col. 5, line 4)

Thus, *Katagiri et al.* merely discloses a transmitter 13 and a receiver 14 for detecting the relative rotational position of the upper and lower plates. Nothing in *Katagiri et al.* shows, teaches or suggests a displacement-detecting means joined to a center of an upper wheel for detecting relative vertical displacement between the upper wheel and the lower wheel as claimed in claim 1. Rather, *Katagiri et al.* merely discloses transmitter 13 and receiver 14 attached to both the upper and lower wheels for detecting rotational displacement.

Additionally, *Katagiri et al.* merely discloses a sensor 15 mounted on an upper surface plate for detecting the width of the gap between the plates 1 and 2. Thus nothing in *Katagiri et al.* shows, teaches or suggests a) a reference table arranged at a position opposing the displacement-detecting means, b) the reference table integrally fixed to a lower wheel or c) the reference table providing a vertical displacement-detection reference position as claimed in claim 1. Rather, *Katagiri et al.* merely discloses a sensor 15 located toward the outer periphery of the upper plate 1.

The combination of Applicants' admitted prior art and *Katagiri et al.* would merely suggest to replace the reference table 22 and the probe 10 of prior art Figure 6 with the peripheral mounted sensor 15 and the receiver and transmitter 14, 13 of *Katagiri et al.* Therefore, nothing in the combination of Applicants' admitted prior art in *Katagiri et al.* show, teach or suggest a reference table integrally fixed to a lower wheel as claimed in claim 1. Therefore, Applicants respectfully request the Examiner withdraws the rejection to claim 1 under 35 U.S.C. §103.

Claim 2 depends from claim 1 and recites additional features. Applicants respectfully submit that claim 2 would not have been obvious within the meaning of 35 U.S.C. §103 over Applicants' admitted prior art in *Katagiri et al.* at least for the reasons as set forth above. Therefore, Applicants respectfully request the Examiner withdraws the rejection to claim 2 under 35 U.S.C. §103.

Claim 3 was rejected under 35 U.S.C. §103 as being unpatentable over Applicants admitted prior art in view of *Katagiri et al.* and further in view of JP 11-77521.

Applicants respectfully traverse the Examiner's rejection of the claim under 35 U.S.C. §103. The claim has been reviewed in light of the Office Action, and for reasons which will be set forth below, Applicants respectfully request the Examiner withdraws the rejection to the claim and allows the claim to issue.

As discussed above, since nothing in the combination of prior art Figure 6 and *Katagiri et al.* show, teach or suggest the primary features as claimed in claim 1, Applicants respectfully submit that the combination of the primary references with the secondary reference to JP 11-77521 will not overcome the deficiencies of the primary references. Therefore, Applicants respectfully request the Examiner withdraws the rejection to claim 3 under 35 U.S.C. §103.

Thus it now appears that the application is in condition for reconsideration and allowance. Reconsideration and allowance at an early date are respectfully requested. Should the Examiner find that the application is not now in condition for allowance, Applicants respectfully request the Examiner enters this Amendment for purposes of appeal.

If for any reason the Examiner feels that the application is not now in condition for allowance, the Examiner is requested to contact, by telephone, the Applicants' undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed within the currently set shortened statutory period, Applicants respectfully petition for an appropriate extension of time. The fees for such extension of time may be charged to our Deposit Account No. 02-4800.

In the event that any additional fees are due with this paper, please charge our Deposit Account No. 02-4800.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

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By: _____
Ellen Marcie Emas
Registration No. 32,131

P.O. Box 1404
Alexandria, Virginia 22313-1404
(703) 836-6620